Open-File Report 92-45

HYDROGEOLOGIC, WATER-QUALITY, STREAMFLOW, BOTTOM-SEDIMENT ANALYSES, AND BIOLOGICAL DATA NEAR THE WAYNE COUNTY LANDFILL, WAYNE COUNTY, TENNESSEE

Prepared by the
U.S. GEOLOGICAL SURVEY

in cooperation with the
TENNESSEE DEPARTMENT OF ENVIRONMENT
AND CONSERVATION,
DIVISION OF SUPERFUND

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By Ferdinand Quiñones, A.D. Bradfield, and J.B. Wescott

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Nashville, Tennessee
1992

U.S. DEPARTMENT OF THE INTERIOR
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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	*By*	*To obtain*
foot (ft)	0.3048	meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
square mile (mi^2)	2.590	square kilometer
gallon per minute (gal/min)	0.06309	liter per second

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows:

$$°F = 1.8 \times °C + 32$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

ABBREVIATED WATER-QUALITY UNITS USED ON TABLES

deg C	degrees Celsius
mg/L	milligrams per liter
μg/L	micrograms per liter
μg/kg	micrograms per kilogram
μS/cm	microsiemens per centimeter

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ABSTRACT

This report summarizes the data collected as part of a hydrogeologic investigation to determine the effects of the Wayne County landfill on local water quality. The investigation was conducted from 1988 through 1989 by the U.S. Geological Survey in cooperation with the Tennessee Department of Health and Environment, Division of Superfund.

The landfill was closed in November 1984 after allegations that contaminants from the landfill were affecting the quality of water from domestic wells in the Banjo Branch-Hardin Hollow valley. Test well construction data; water-quality data for selected wells, seeps, and surface-water sites; streamflow data from Banjo Branch; analyses of bottom-sediment samples; and biological data for the study area are documented in this report.

INTRODUCTION

The Wayne County landfill (fig. 1) is located on a ridgetop about 6 miles southwest of the city of Waynesboro (Wayne County) in south-central Tennessee. The landfill operated from August 1976 through November 1984. It was closed by the Tennessee Department of Health and Environment (TDHE) (*Tennessee Department of Environment and Conservation as of 1991*) because of allegations that contaminants from the landfill were affecting the quality of water from domestic wells in the Banjo Branch-Hardin Hollow valley. A preliminary study conducted by TDHE in 1987 showed that barium and methyl-ethyl ketones were present in leachate discharging from the landfill (Moss, 1987). A further study conducted by Garman and Fischer (1988) showed that shallow domestic wells in the valley are hydraulically connected to the landfill. On October 19, 1988, the landfill was classified as an "inactive hazardous-substances site" by the Solid Waste Control Board of TDHE (T. Moss, oral commun., 1988).

The preliminary studies conducted in 1987 and 1988 included only surface-soil and water samples. The migration of contaminated leachate from the landfill to streams in the valley and to the shallow and deep ground-water systems in the area was not defined. Landfills and other waste sites containing toxic materials

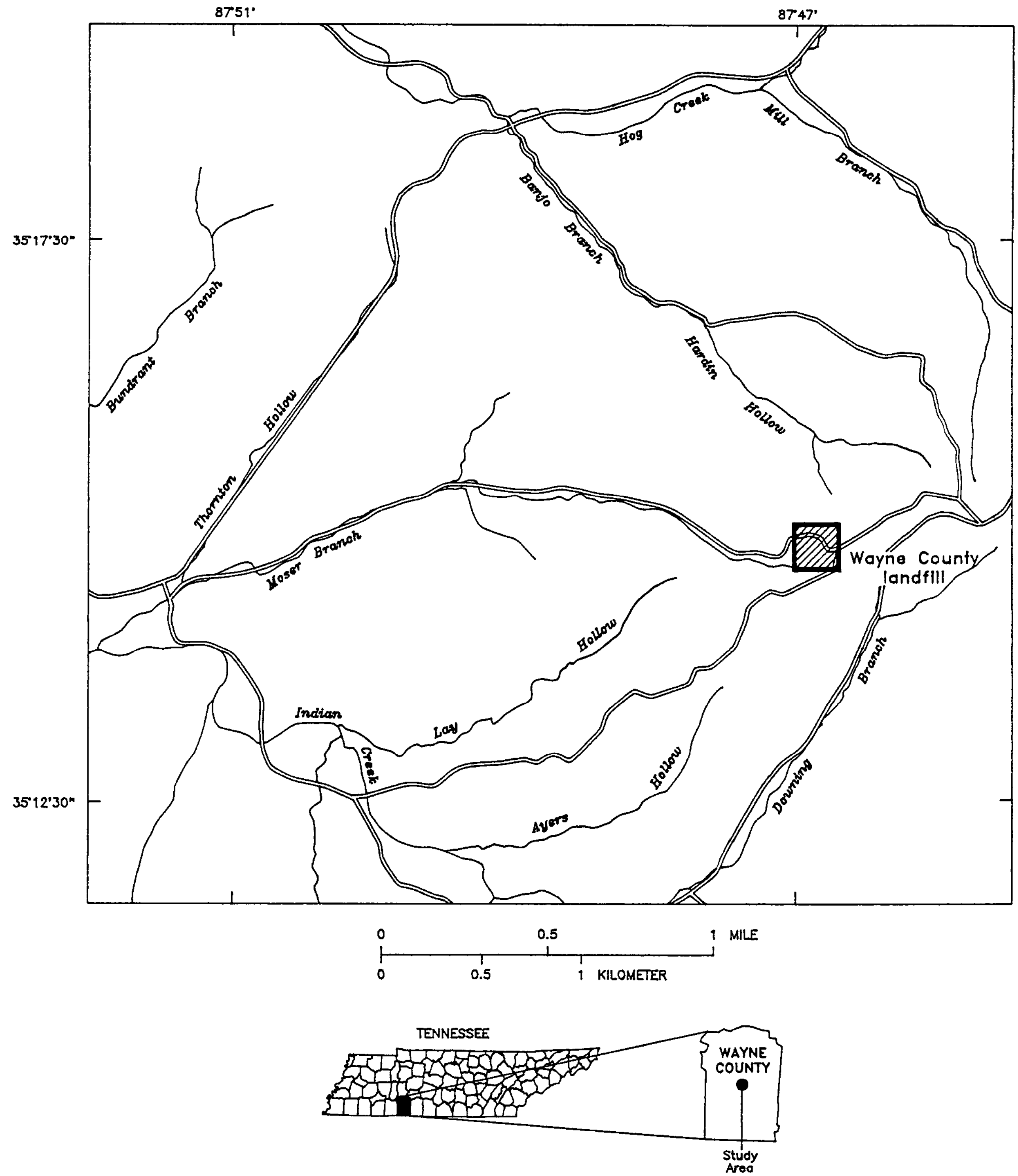


Figure 1.--Location of the Wayne County landfill.

occur throughout Tennessee (Broshears, 1988) in areas such as Wayne County, where limestone rocks, sink-holes, and other karst features predominate. Federal, State, and local agencies were interested in further studies that could provide data essential for future regulatory activities.

The U.S. Geological Survey (USGS), as part of its water-resources investigations programs in Tennessee, conducts studies designed to define the hydrogeology of karst areas. The data from these studies can be used to better understand the processes governing surface-water and ground-water-flow systems at similar hydrologic settings in other states. Accordingly, in 1988, the USGS, in cooperation with the TDHE, Division of Superfund, initiated a comprehensive investigation of the hydrogeology near the Wayne County landfill. This report summarizes the data collected during the study.

DATA-COLLECTION ACTIVITIES

Data-collection activities during the project included the following:

1. Drilling of 16 shallow and deep wells.
2. Geophysical testing of the boreholes.
3. Development and testing of each well for determination of specific capacity and other aquifer properties.
4. Collection and analyses of water samples from each well drilled during the project, and from streams and seeps near the landfill.
5. Collection and analyses of samples of fish, benthic macroinvertebrates, and algae from the streams receiving leachate from the landfill.
6. Measurement of continuous discharge at a site on Banjo Branch downgradient from the landfill.
7. Collection and analyses of bottom-sediment samples at two sites.

The sites at which data were collected are shown in figures 1 through 6 and described in tables 1 through 9 (in back of report).

Test Well Construction

Sixteen test wells were drilled from March through June 1988. The wells were located on the ridge near the landfill and in Hardin Hollow (fig. 2). An air-rotary rig was used to drill a 9.25-inch-diameter borehole to within 10 feet of the target depth interval. After installation of nominal 6-inch-diameter galvanized steel casing, the annular space was cemented to land surface. The wells were completed by drilling a 5.75-inch-diameter borehole to total depth, and were left as open holes below the bottom of the casing. Well development was completed with air lifting, and water levels were measured as soon as hydraulic heads achieved equilibrium. The total depth, depth to water upon completion, the formations at which screens were installed, and other characteristics of each well are summarized in table 2.

Geophysical Data

Geophysical logs were obtained from each well using a borehole geophysical logger. Logs were obtained to determine natural gamma, fluid resistivity, temperature, and caliper. A sample plot from one

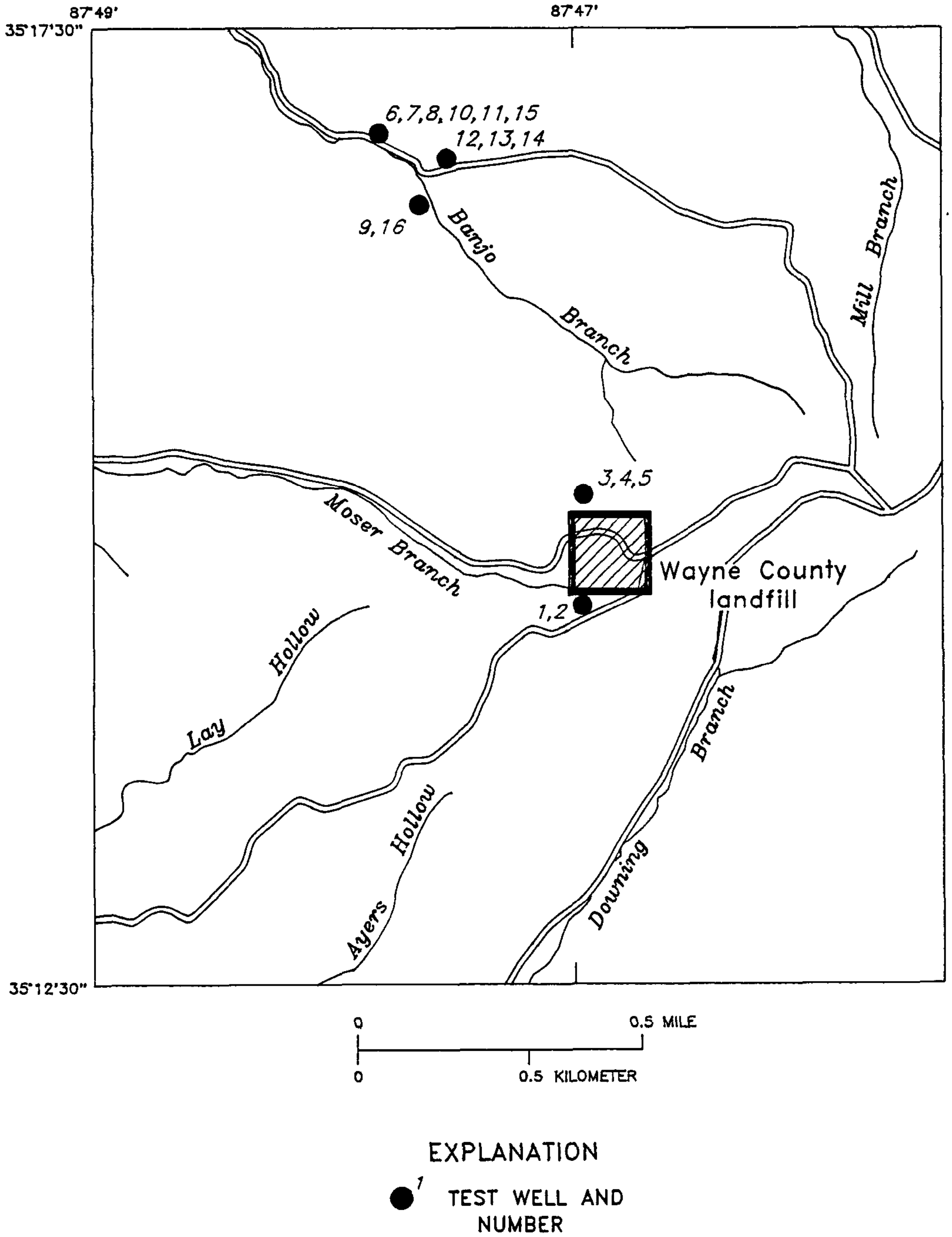


Figure 2.--Location of test wells near the Wayne County landfill.

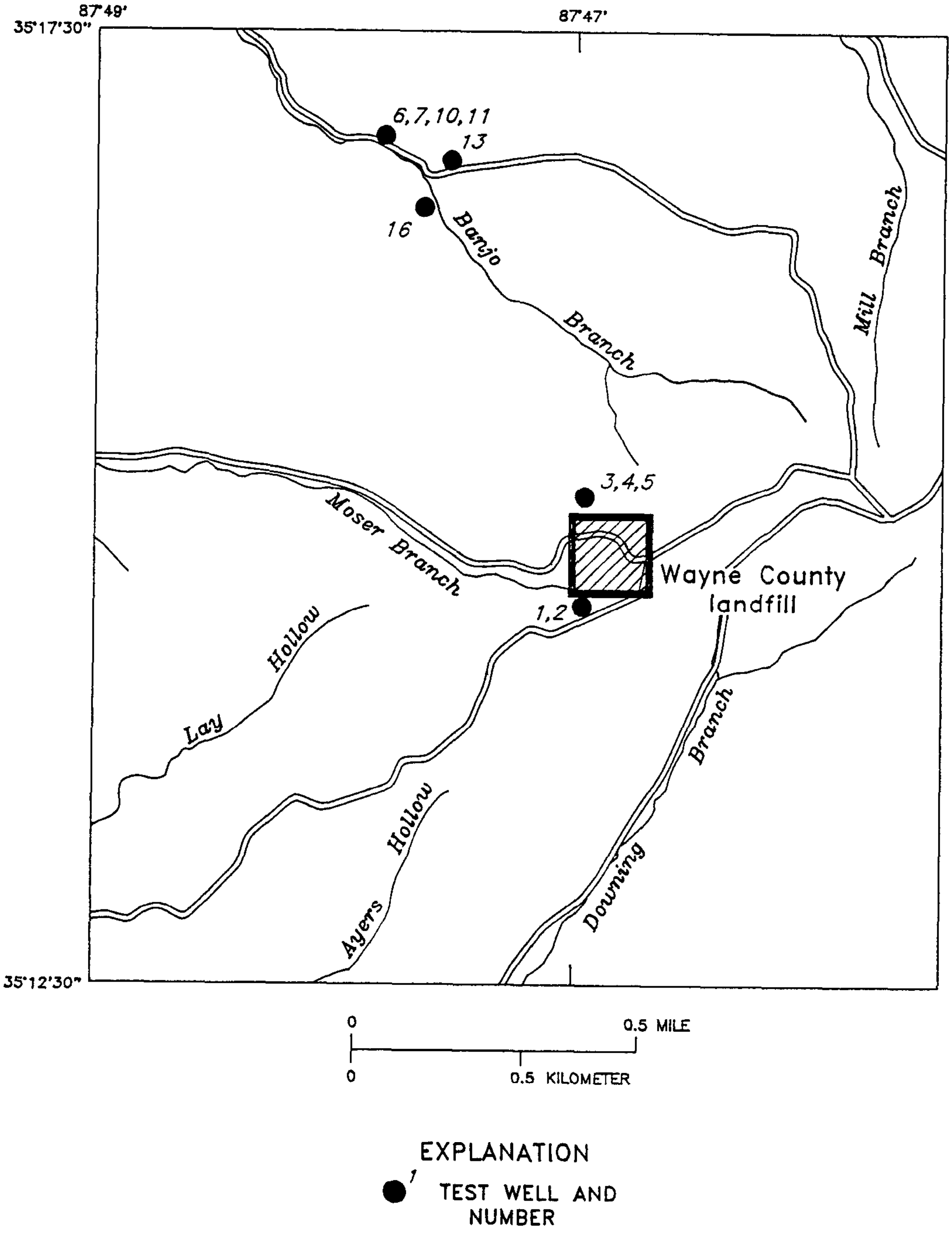


Figure 3.--Location of test wells near the Wayne County landfill from which samples were collected.

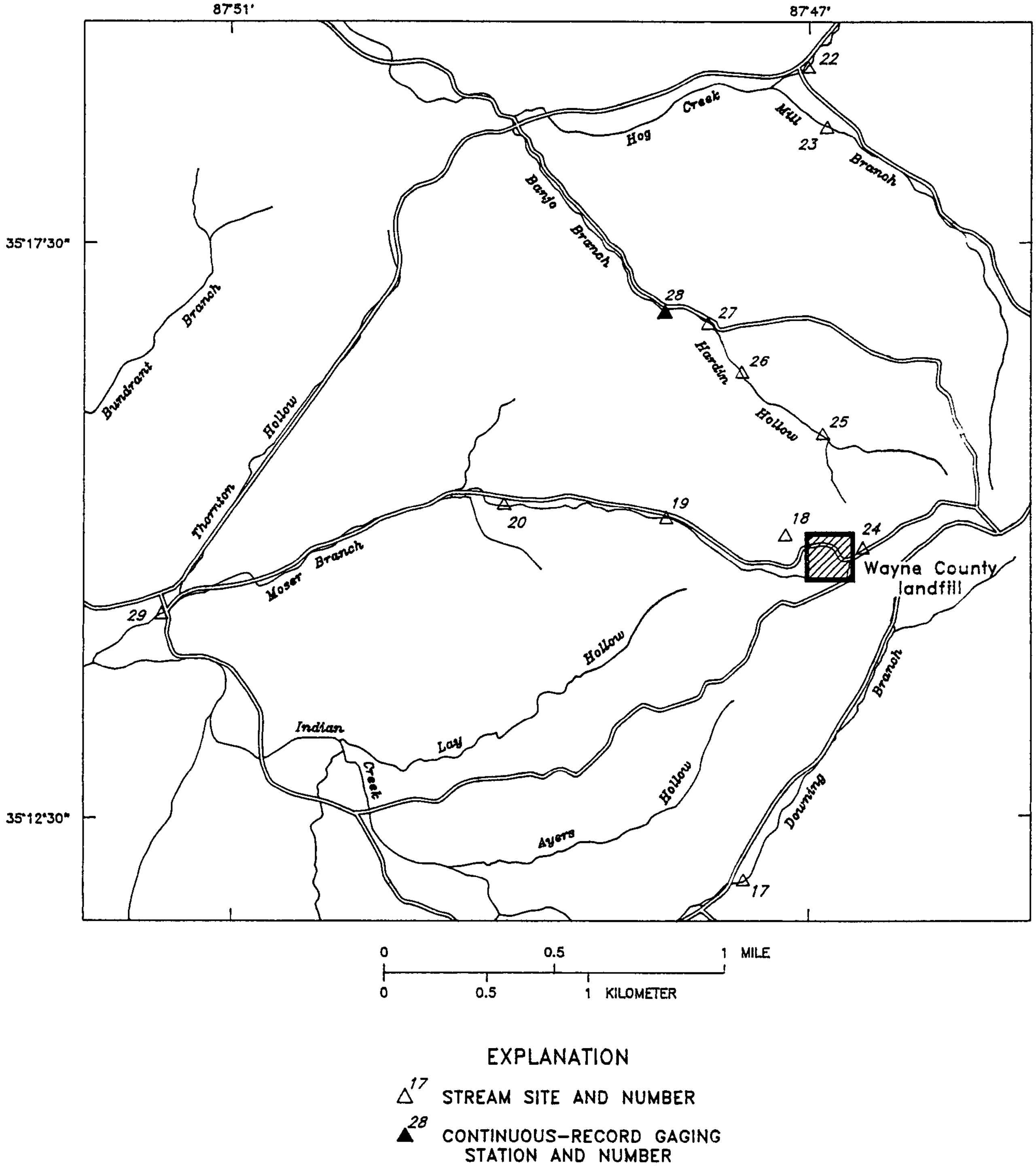
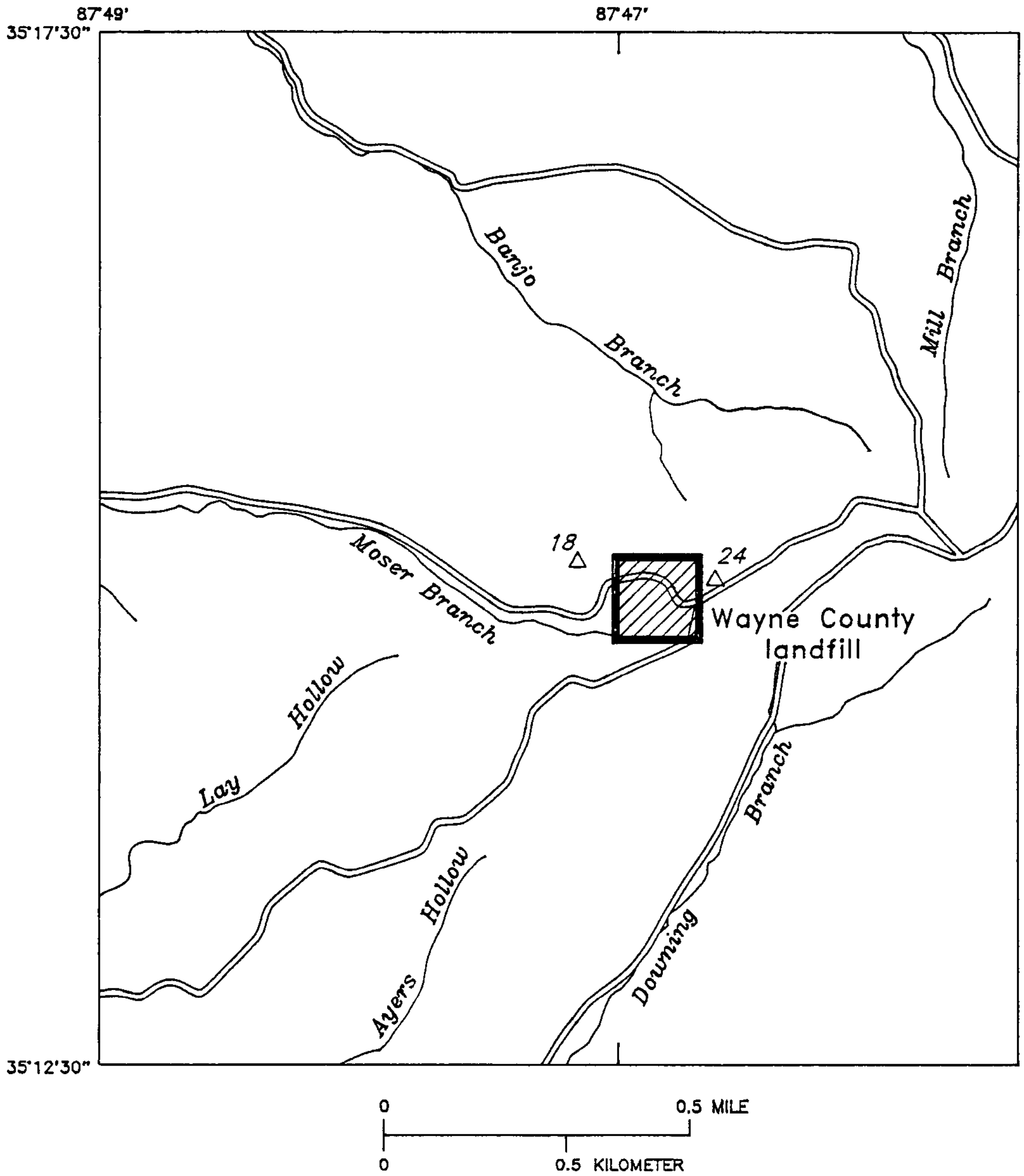


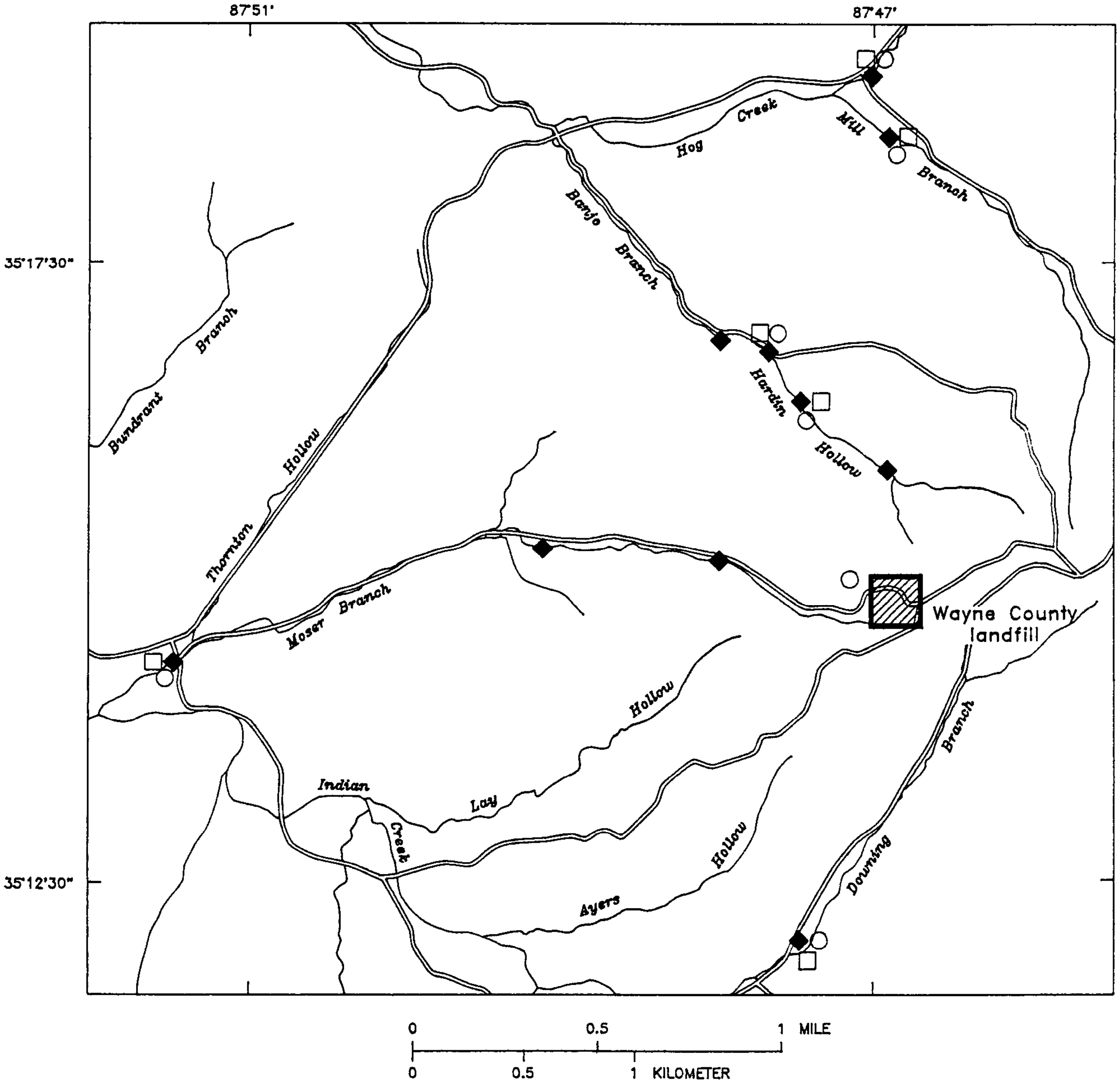
Figure 4.--Location of sites from which samples were collected and continuous-record gaging station at Banjo Branch.



EXPLANATION

△18 STREAM SITE AND NUMBER

Figure 5.--Location of sites from which bottom-sediment samples were collected.



EXPLANATION

SAMPLE TYPE

◆ Benthic

☐ Fish

○ Algae

Figure 6.--Location of sites from which biological samples were collected.

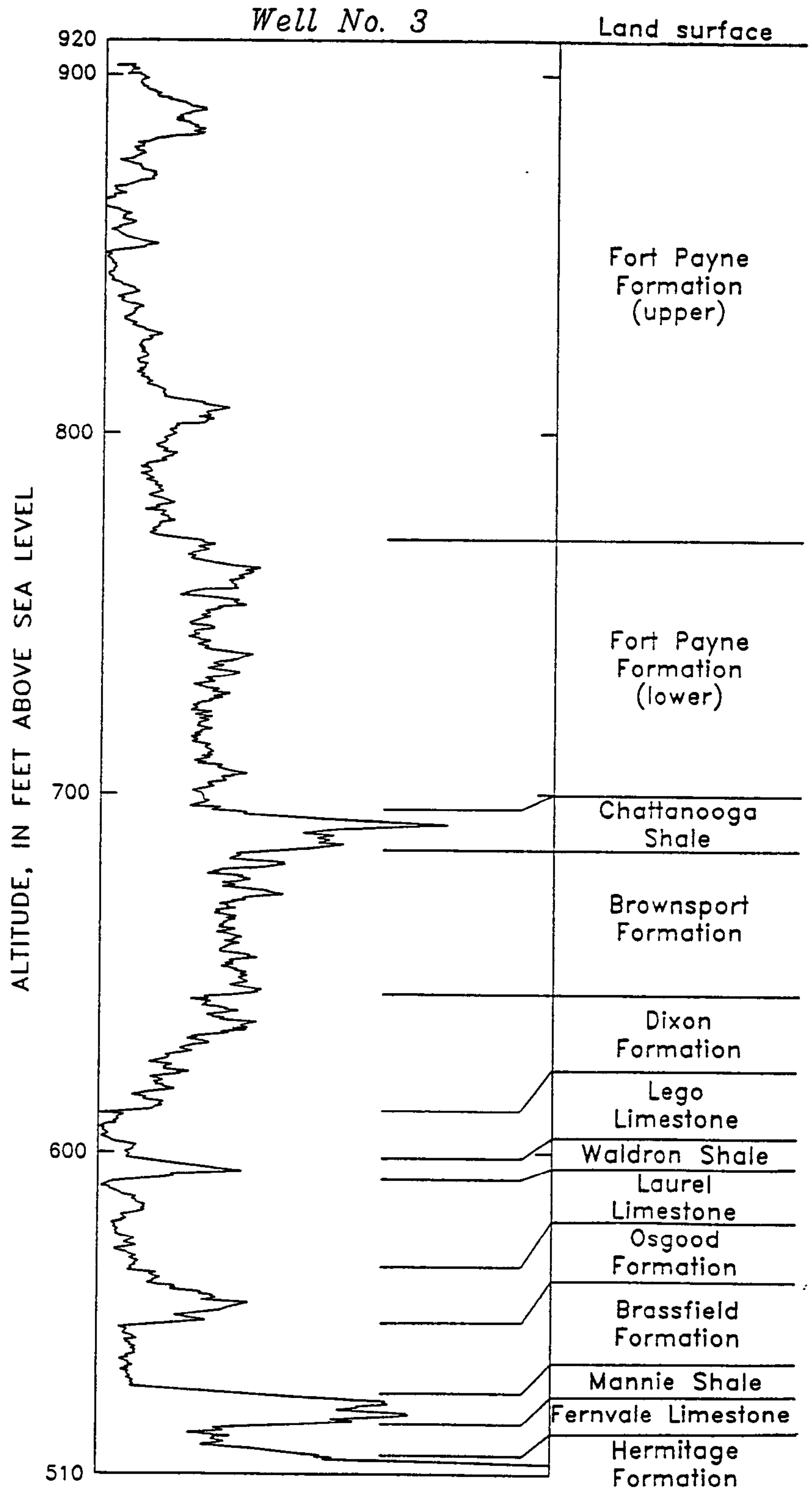


Figure 7.--Geophysical logs showing formations encountered near the Wayne County landfill. (From Miller, 1974.)

of the logs is shown in figure 7. The geophysical data are not published in this report because of its volume; the data can be inspected at the USGS offices in Nashville.

Water-Quality Data

Water samples were collected from selected test wells with submersible pumps and bailers according to methods described by Wershaw and others (1987). Surface-water grab samples were collected at selected sites on creeks and seeps draining the ridge according to methods described by Skougstad and others (1979). Field determinations were made of the pH, specific conductance, temperature, and alkalinity of each sample. The samples were analyzed at the USGS National Water Quality laboratory in Arvada, Colorado, using methods described by Skougstad and others (1979), and Britton and Greeson (1987). Determinations were made for principal anions and cations, nutrients, trace metals, and selected organic compounds.

Wells and Seeps

Water samples were collected from wells drilled on the ridge (wells 1-5), and selected wells in the valley downgradient from the landfill (wells 6, 7, 10, 11, 13, and 16) (fig. 3). However, because of relatively low specific-capacity values and extreme depth to water of wells on the ridge, only one casing volume was removed before the samples were collected. At least three casing volumes were removed before collection of samples from wells in the valley. The results of the chemical and physical analyses of the samples are summarized in table 3.

Surface-water Sites

Surface-water samples were collected from sites 17 through 20 and 22 through 29 (fig. 4) during June 1988 and July 1989. Samples were collected twice at most of the sites. Results of the analyses are summarized in table 4.

Streamflow

Continuous-streamflow data were collected from May 1988 to December 1988, and from April 1989 to September 1989 at Banjo Branch just upstream from its confluence with Hog Creek (fig. 4). The streamflow data are summarized in table 5.

Bottom-Sediment Analyses

Bottom-sediment samples were collected from a seep that forms Moser Branch (site 18, fig. 5), and from the sediment-retention pond downslope from the landfill (site 24, fig. 5). The sediment samples were analyzed for organic compounds, including chlorinated pesticides and polychlorinated biphenyls (PCB's). The results of the analyses are summarized in table 6.

Biological Data

Benthic invertebrate samples were collected in June 1988 from eight sites and in July 1989 from six of the previous sites (fig. 6). Samples of fish and algal communities were collected in July 1989 at six of the eight sites. The benthic invertebrate samples were collected with a 210-micron mesh according to methods described by Britton and Greeson (1987). The fish samples were collected using a backpack electric fishing unit. The benthic macroinvertebrate and the algae samples were analyzed at Austin Peay State University. The fish tissue analyses were performed by the Mississippi State Chemical Laboratory. Tissue samples from whole fish were analyzed for occurrence and concentration of organochlorine pesticides and gross PCB's. Non-quantitative algal samples were collected by scrapping rocks from streambeds. All organisms were identified to species whenever possible.

The results of the benthic invertebrate analyses, including species determinations and the Shannon-Weaver diversity index (Shannon and Weaver, 1949) are summarized in table 7. The results of the analyses of the algal populations, including species and percent of relative abundance, are summarized in table 8. The results of the fish sampling and analyses are summarized in table 9.

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Table 1.--*Identification data for wells and surface-water sampling sites near the Wayne County landfill*

Test well number (see fig. 2) or stream name and site number (see fig. 4)	U.S. Geological Survey identification number
1	[a]351408087474001
2	351407087474101
3	351420087474001
4	351420087474101
5	351420087474201
6	351526087490601
7	351526087490701
8	351512087472701
10	351525087490901
11	351527087490701
15	351527087482301
9	351512087472701
16	351310087492401
12	351522087480701
13	351521087480901
14	351520087481101
Downing Branch, site 17	[b]035941368
Moser Branch (at headwaters), site 18	035941378
Moser Branch, site 19	03594138
Moser Branch, site 20	035941386
Hog Creek, site 22	035941634
Mill Branch, site 23	035941635
Sediment-retention pond, site 24	035941636
Banjo Branch tributary, site 25	035941637
Banjo Branch tributary, site 26	035941638
Banjo Branch, site 27	035941639
Banjo Branch near Waynesboro, site 28	03594164
Moser Branch (at county road bridge), site 29	03594139

[a] Station numbers provide a unique 15-digit number for each well, based on geographic location. The first 6 digits denote degrees, minutes, and seconds of latitude; the next 7 digits denote degrees, minutes, and seconds of longitude; and the last 2 digits, assigned sequentially, identify the well within a 1-second grid.

[b] A "downstream order" system is used to identify surface-water stations. The complete number of each station such as 03594139...., which appears just to the left of the station name, includes the 2-digit part number "03" plus the multi-digit downstream order number "594139...." This downstream numbering system is used in most cases; however, in some cases latitude and longitude numbers are assigned to hydrologic stations and partial-record stations as a means of identification.

Table 2.--*Construction and water-level data for wells near the Wayne County landfill, September 13, 1988*

[-, elevation of water above land surface; gal/min/ft, gallons per minute per foot; --, no data available]

Test well number	Depth of well, in feet below land surface	Depth of casing, in feet below land surface	Column of open hole, in feet	Depth to water, in feet below land surface	Approximate specific capacity, in gal/min/ft	Formations to which well is open (Miller, 1974)
1	320	230	90	214.09	--	Decatur Limestone, Brownsport Formation, Dixson Formation, Lego Limestone
2	195	108	87	95.64	0.03	Fort Payne Formation (upper and lower members)
3	400	246	154	202.20	--	Brownsport Formation to Hermitage Formation
4	203	157	46	96.78	0.02	Fort Payne Formation (lower member only)
5	140	93	47	64.26	3.0	Fort Payne Formation (upper member only)
6	40	23	17	3.02	0.03	Laurel Limestone, Osgood Formation
7	105	71	34	-4.30	0.10	Mannie Shale, Fernvale Limestone, Hermitage Formation
8	70	45	25	-4.16	1.6	Brassfield Limestone
10	70	45	25	-2.78	36.0	Brassfield limestone
11	70	45	25	2.13	--	Osgood Formation, Brassfield Limestone
15	70	39	31	8.07	--	Osgood Formation, Brassfield Limestone
9	32	24	8	13.68	--	Laurel Limestone
16	66	49	17	14.49	0.90	Laurel Limestone, Osgood Formation
12	100	70	30	25.84	0.01	Brassfield Limestone, Mannie Shale, Fernvale Limestone
13	51	40	11	12.80	0.68	Laurel Limestone, Osgood Formation
14	39	19	20	12.52	--	Laurel Limestone

Table 3.--*Water-quality data for selected wells near the Wayne County landfill*

[deg C, degrees Celsius; μS/cm, microsiemens per centimeter; IT, incremental titration; mg/L, milligrams per liter; μg/L, micrograms per liter; *, measurement affected by water of hydration from grout around casing; <, below the level of detection, if present; noncarb, noncarbonate; fld., fluid]

Test well number	Date	Temperature water (deg C)	Color (platinum-cobalt) (units)	Specific conductance lab (μS/cm)	Alkalinity field, IT (mg/L as $CaCO_3$)	Alkalinity lab, IT (mg/L as $CaCO_3$)	pH, field (standard units)	pH, lab (standard units)	Solids, residue at 180 deg. C dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)
1	06-21-89	16.5	5	448	123	113	8.85	8.40	286	274
2	06-23-89	15.5	5	322	130	124	8.44	8.70	179	187
3	06-21-89	16.5	5	683	69	66	7.76	8.10	512	474
4	06-23-89	16.0	5	818	196*	90	11.37*	10.80*	365	395
5	06-22-89	15.5	5	70	26	27	6.23	6.60	28	43
6	06-21-89	16.0	5	298	116	103	8.35	8.30	178	162
7	06-21-89	16.0	15	1,500	280	230	8.62	8.70	929	958
10	06-20-89	16.0	5	369	112	116	7.83	7.90	229	214
11	06-20-89	15.0	5	244	100	100	8.04	8.10	137	138
13	06-21-89	14.5	5	501	178	175	7.60	7.70	274	285
16	06-22-89	15.0	5	1,070	81	83	8.11	8.00	787	735

Test well number	Hardness total (mg/L as $CaCO_3$)	Hardness noncarb dissolved fld. as $CaCO_3$ (mg/L)	Calcium dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Manganese, dissolved (μg/L as Mn)	Mercury total recoverable (μg/L as Hg)
1	150	26	30	18	32	5.9	3.9	110	0.40	6.3	5	<0.10
2	100	0	23	11	28	2.6	5.6	34	.30	8.1	13	< .10
3	350	0	120	11	4.1	1.1	1.7	290	.10	6.3	27	< .10
4	110	0	41	1.7	100	13	140	36	.20	8.8	<1	< .10
5	30	4	8.1	2.3	1.9	.10	3.8	2	.10	8.4	28	< .10
6	120	4	30	11	10	2	10	31	.20	6.4	25	< .10
7	89	0	16	12	280	3.8	58	440	2.7	7.9	4	< .10
10	170	62	50	12	4.4	1.2	2.9	66	.20	8	8	< .10
11	120	19	36	7	1.7	.90	2.1	23	.10	7.2	1	< .10
13	230	220	66	17	10	2	11	66	.10	7.7	15	< .10
16	350	270	68	44	85	3.7	2	450	1.1	10	13	< .10

Test well number	Nickel, total recoverable (μg/L as Ni)	Silver, total recoverable (μg/L as Ag)	Zinc, total recoverable (μg/L as Zn)	Antimony, total (μg/L as Sb)	Arsenic total (μg/L as As)	Beryllium, total recoverable (μg/L as Be)	Cadmium total recoverable (μg/L as Cd)	Chromium, total recoverable (μg/L as Cr)	Copper, total recoverable (μg/L as Cu)	Iron, dissolved (μg/L as Fe)	Lead, total recoverable (μg/L as Pb)	Selenium, total (μg/L as Se)	Dichlorobromomethane total recoverable (μg/L)
1	2	<1	3,300	<1	<1	<10	<1	<1	6	5	29	<1	<3
2	5	<1	170	1	1	<10	<1	<1	6	4	6	17	<3
3	<1	<1	360	<1	<1	<10	<1	<1	2	110	1	<1	<3
4	3	<1	6,100	1	1	<10	<1	11	18	4	300	1	<3
5	3	<1	130	<1	<1	<10	<1	<1	4	9	2	<1	<3
6	<1	<1	2,400	1	1	<10	<1	<1	2	7	8	<1	<3
7	<1	<1	9,800	2	2	<10	<1	<1	4	9	8	<1	<3
10	<1	<1	90	<1	<1	<10	<1	<1	2	67	2	<1	<3
11	3	<1	20	<1	<1	<10	<1	<1	4	11	3	<1	<3
13	<1	<1	30	<1	<1	<10	<1	<1	2	280	1	<1	<3
16	1	<1	790	<1	<1	<10	<1	<1	4	8	4	<1	<3

Table 3.--*Water-quality data for selected wells near the Wayne County landfill*--Continued

Test well number	Carbon-tetra-chloride total recov-able (µg/L)	1,2-Di-chloro-ethane total recov-able (µg/L)	Bromo-form total recov-able (µg/L)	Chloro-di-bromo-methane total recov-erable (µg/L)	Chloro-form total recov-erable (µg/L)	Toluene total recov-erable (µg/L)	Benzene total recov-erable (µg/L)	Xylene total recov-erable (µg/L)	Chloro-benzene total recov-erable (µg/L)	Chloro-ethane total recov-erable (µg/L)	Ethyl-benzene total recov-erable (µg/L)	Methyl-bromide total recov-erable (µg/L)
1	<3	<3	<3	<3	<3	22	<3	<3	<3	<3	4	<3
2	<3	<3	<3	<3	<3	<3	<3	5.3	<3	<3	<3	<3
3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
4	<3	<3	<3	<3	<3	5.5	<3	8.1	<3	<3	3.6	<3
5	<3	<3	<3	<3	<3	<3	<3	11	<3	<3	<3	<3
6	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
7	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
10	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
11	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
13	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
16	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3

Test well number	Methyl-chlo-ride total recov-erable (µg/L)	Methyl-ene chlo-ride total recov-erable (µg/L)	Tetra-chloro-ethyl-ene total recov-erable (µg/L)	Tri-chloro-fluoro-methane total recov-erable (µg/L)	1,1-Di-chloro-ethane total recov-erable (µg/L)	1,1-Di-chloro-ethyl-ene total recov-erable (µg/L)	1,1,1-Tri-chloro-ethane total recov-erable (µg/L)	1,1,2-Tri-chloro-ethane total recov-erable (µg/L)	1,1,2,2 Tetra-chloro-ethane total recov-erable (µg/L)	1,2-Di-chloro-benzene total recov-erable (µg/L)	1,2-Di-chloro-propane total recov-erable (µg/L)	1,2-Transdi-chloro-ethene total recov-erable (µg/L)
1	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
2	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
4	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
5	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
6	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
7	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
10	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
11	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
13	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
16	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3

Test well number	1,3-Di-chloro-propene total recov-erable (µg/L)	2-Chloro-1,3-Di-chloro-benzene total recov-erable (µg/L)	Di-chloro-1,4-Di-chloro-benzene total recov-erable (µg/L)	Trans-ethyl-vinyl-ether total recov-erable (µg/L)	Cis di-fluoro-methane total recov-erable (µg/L)	1,3-Di-chloro-propene total recov-erable (µg/L)	1,3-Di-chloro-propene total recov-erable (µg/L)	Per-thane total recov-erable (µg/L)	Vinyl chlo-ride total recov-erable (µg/L)	Tri-chloro-ethyl-ene total recov-erable (µg/L)
1	<3	<3	<3	<3	<3	<3	<3	<0.1	<1	<3
2	<3	<3	<3	<3	<3	<3	<3	< .1	<1	<3
3	<3	<3	<3	<3	<3	<3	<3	< .1	<3	<3
4	<3	<3	<3	<3	<3	<3	<3	< .1	<1	<3
5	<3	<3	<3	<3	<3	<3	<3	< .1	<1	<3
6	<3	<3	<3	<3	<3	<3	<3	< .1	<3	<3
7	<3	<3	<3	<3	<3	<3	<3	< .5	<1	<3
10	<3	<3	<3	<3	<3	<3	<3	< .1	<1	<3
11	<3	<3	<3	<3	<3	<3	<3	< .1	<1	<3
13	<3	<3	<3	<3	<3	<3	<3	< .1	<1	<3
16	<3	<3	<3	<3	<3	<3	<3	< .1	<1	<3

Table 3.--*Water-quality data for selected wells near the Wayne County landfill*--Continued

Test well number	Naphthalenes polychlor-total recoverable (µg/L)	Aldrin, total recoverable (µg/L)	Lindane total recoverable (µg/L)	Dane, total recoverable (µg/L)	DDD, total recoverable (µg/L)	DDE, total recoverable (µg/L)	DDT, total recoverable (µg/L)	Dieldrin total recoverable (µg/L)	Endosulfan, total recoverable (µg/L)	Endrin, total recoverable (µg/L)	Toxaphene, total recoverable (µg/L)	Heptachlor, total recoverable (µg/L)
1	<0.10	<0.010	<0.010	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<1	<0.010
2	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010
3	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010
4	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010
5	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010
6	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010
7	< .50	< .050	< .050	< .5	< .050	< .050	< .050	< .050	< .050	< .050	<5	< .050
10	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010
11	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010
13	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010
16	< .10	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010

Test well number	Heptachlor epoxide total recoverable (µg/L)	Methoxychlor, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)	Styrene total recoverable (µg/L)	1,2-Dibromoethane total recoverable (µg/L)
1	<0.010	<0.01	<0.1	<0.01	<3	<3
2	< .010	< .01	< .1	< .01	<3	<3
3	< .010	< .01	< .1	< .01	<3	<3
4	< .010	< .01	< .1	< .01	<3	<3
5	< .010	< .01	< .1	< .01	<3	<3
6	< .010	< .01	< .1	< .01	<3	<3
7	< .050	< .05	< .5	< .05	<3	<3
10	< .010	< .01	< .1	< .01	<3	<3
11	< .010	< .01	< .1	< .01	<3	<3
13	< .010	< .01	< .1	< .01	<3	<3
16	< .010	< .01	< .1	< .01	<3	<3

Table 4.--*Water-quality data for selected surface-water sites near the Wayne County landfill, June 1988 and July 1989*

[--, indicates no data; <, less than detection limit, if present; µS/cm microsiemens per centimeter; deg C, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; IT, incremental titration]

Site number	Date	Streamflow, instantaneous, in feet per second	Specific conductance, field (µS/cm)	Specific conductance, lab (µS/cm)	pH, field (standard units)	pH lab, (standard units)	Temperature (deg C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Alkalinity, field, IT (mg/L as $CaCO_3$)
17	07-13-89	--	120	145	7.31	7.70	21	69	23	2.7	1.2	0.80	62
18	07-11-89	--	380	392	7.27	7.50	21	110	37	4.7	25	9.2	134
19	06-29-88	<0.01	--	51	7.10	7.20	23.5	19	5.2	1.4	1.8	.80	16
20	06-29-88	.08	--	61	7.60	7.20	26.0	26	7.3	1.8	1.4	.60	23
22	06-30-88	.52	--	84	7.40	7.40	22.0	38	11	2.4	1.1	.80	35
22	07-12-89	--	--	68	7.33	7.30	23.5	28	7.9	1.9	1.1	2.0	27
23	06-30-88	.93	--	83	8.10	7.60	--	39	12	2.2	1.0	.40	37
23	07-12-89	--	50	51	7.55	7.40	22	21	6.0	1.4	.90	.50	19
24	06-30-88	--	--	62	7.40	6.70	26.5	23	6.1	1.9	1.5	1.8	19
24	07-13-89	--	50	48	6.22	6.50	23	16	4.6	1.2	1.4	1.5	14
25	06-29-88	.20	--	70	7.90	7.40	21.5	30	8.4	2.2	1.1	.30	29
26	06-30-88	.24	--	82	7.65	7.50	20.5	36	10	2.6	1.2	.40	37
26	07-12-89	--	50	49	7.34	7.60	20.5	21	6.0	1.5	1.3	.90	18
27	06-28-88	.27	--	140	7.10	7.10	15.5	69	22	3.4	1.1	.70	67
27	07-12-89	--	121	118	7.56	7.60	17	57	19	2.2	1.1	1.0	--
28	06-28-88	.32	--	102	8.05	7.90	19.5	65	21	3.0	1.3	.60	66
29	07-13-89	--	70	86	7.65	7.80	21	38	12	1.9	1.1	.50	34

Site number	Date	Alkalinity, lab, IT (mg/L as $CaCO_3$)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 deg. C dissolved (mg/L)	Solids, sum of constituents dissolved (mg/L)	Color (platinum-cobalt units)	Nitrogen, nitrite plus nitrate total recoverable (mg/L as N)	Nitrogen, ammonia total recoverable (mg/L as N)	Nitrogen, ammonia, total recoverable (mg/L as NH_4)	Phosphorus, ortho, total recoverable (mg/L as P)
17	07-13-89	63	8.0	1.0	0.10	8.3	85	--	10	--	--	--	--
18	07-11-89	128	6.0	32	.10	6.0	236	--	75	--	--	--	--
19	06-29-88	16	3.0	3.3	< .10	8.3	34	33	<5	0.070	0.020	0.03	0.020
20	06-29-88	22	3.0	2.6	< .10	8.3	38	38	5	.040	.020	.03	.020
22	06-30-88	32	5.0	2.2	< .10	7.7	48	50	5	.220	.020	.03	.030
22	07-12-89	22	7.0	1.3	.10	8.2	38	--	18	--	--	--	--
23	06-30-88	35	3.0	1.8	< .10	8.1	52	50	5	.100	.020	.03	.100
23	07-12-89	17	6.0	1.0	.10	8.0	41	--	10	--	--	--	--
24	06-30-88	17	6.0	2.6	< .10	1.1	44	31	5	< .020	.010	.01	.030
24	07-13-89	14	5.0	1.0	.10	7.1	31	--	380	--	--	--	--
25	06-29-88	28	2.0	2.3	< .10	7.9	46	41	5	.050	.020	.03	.030
26	06-30-88	34	3.0	2.2	< .10	8.1	54	48	5	.060	.030	.04	.070
26	07-12-89	13	7.0	1.2	.10	8.0	35	--	15	--	--	--	--
27	06-28-88	62	5.0	2.2	< .10	7.7	106	79	5	< .020	.030	.04	.080
27	07-12-89	49	9.0	0.80	.10	8.0	79	--	32	--	--	--	--
28	06-28-88	47	3.0	4.0	< .10	7.5	114	69	5	< .020	.010	.01	.260
29	07-13-89	32	8.0	0.70	< .10	8.4	58	--	20	--	--	--	--

Table 4.--*Water-quality data for selected surface-water sites near the Wayne County landfill, June 1988 and July 1989*--Continued

Site number	Date	Phosphate, total recoverable (mg/L as PO_4)	Carbon, organic total recoverable (mg/L as C)	Arsenic, total recoverable (µg/L as As)	Barium, dissolved (µg/L as Ba)	Boron, dissolved (µg/L as B)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)	Lithium, dissolved (µg/L as Li)	Manganese, dissolved (µg/L as Mn)	Strontium, dissolved (µg/L as Sr)	Mercury, dissolved (µg/L as Hg)	Beryllium, total recoverable (µg/L as Be)
17	07-13-89	--	--	<1	--	--	24	--	--	12	--	--	<10
18	07-11-89	--	--	<1	--	--	50	--	--	670	--	--	<10
19	06-29-88	0.06	1.6	--	<100	<20	30	<5	<10	<10	10	0.3	--
20	06-29-88	.06	1.9	--	<100	<20	30	<5	<10	<10	10	.2	--
22	06-30-88	.09	2.8	--	<100	<20	30	<5	<10	<10	130	.3	--
22	07-12-89	--	--	<1	--	--	32	--	--	7	--	--	<10
23	06-30-88	.31	1.2	--	<100	<20	30	<5	<10	<10	90	.3	--
23	07-12-89	--	--	<1	--	--	32	--	--	4	--	--	<10
24	06-30-88	.09	6.2	--	<100	30	50	<5	<10	<10	30	.2	--
24	07-13-89	--	--	1	--	--	380	--	--	500	--	--	<10
25	06-29-88	.09	--	--	<100	<20	<10	<5	<10	10	50	< .1	--
26	06-30-88	.21	1.5	--	<100	<20	10	<5	<10	10	80	.4	--
26	07-12-89	--	--	<1	--	--	32	--	--	16	--	--	<10
27	06-28-88	.25	8.2	--	<100	<20	<10	<5	<10	30	140	.4	--
27	07-12-89	--	--	<1	--	--	33	--	--	31	--	--	<10
28	06-28-88	.80	--	--	<100	<20	30	<5	<10	30	130	.2	--
29	07-13-89	--	--	<1	--	--	68	--	--	21	--	--	<10

Site number	Date	Cadmium, total recoverable (µg/L as Cd)	Chromium, total recoverable (µg/L as Cr)	Copper, total recoverable (µg/L as Cu)	Lead, total recoverable (µg/L as Pb)	Mercury, total recoverable (µg/L as Hg)	Nickel, total recoverable (µg/L as Ni)	Selenium, total recoverable (µg/L as Se)	Silver, total recoverable (µg/L as Ag)	Zinc, total recoverable (µg/L as Zn)	Antimony, total recoverable (µg/L as Sb)	Perthane, total recoverable (µg/L)	Naphthalenes, polychlor. total recoverable (µg/L)
17	07-13-89	<1	<1	3	<1	<0.10	<1	<1	<1	<10	<1	<0.1	<0.10
18	07-11-89	<1	2	20	7	< .10	2	<1	<1	220	<1	< .1	< .10
19	06-29-88	--	--	--	--	--	--	--	--	--	--	--	--
20	06-29-88	--	--	--	--	--	--	--	--	--	--	--	--
22	06-30-88	--	--	--	--	--	--	--	--	--	--	--	--
22	07-12-89	1	1	3	4	< .10	3	<1	<1	40	<1	< .1	< .10
23	06-30-88	--	--	--	--	--	--	--	--	--	--	--	--
23	07-12-89	<1	<1	2	1	< .10	5	<1	<1	<10	<1	< .1	< .10
24	06-30-88	--	--	--	--	--	--	--	--	--	--	--	--
24	07-13-89	<1	6	2	4	< .10	7	<1	<1	70	<1	< .1	< .10
25	06-29-88	--	--	--	--	--	--	--	--	--	--	--	--
26	06-30-88	--	--	--	--	--	--	--	--	--	--	--	--
26	07-12-89	<1	<1	2	2	< .10	1	<1	<1	40	<1	< .1	< .10
27	06-28-88	--	--	--	--	--	--	--	--	--	--	--	--
27	07-12-89	<1	30	3	1	< .10	3	<1	<1	<10	<1	< .1	< .10
28	06-28-88	--	--	--	--	--	--	--	--	--	--	--	--
29	07-13-89	<1	1	2	1	< .10	5	<1	<1	<10	<1	< .1	< .10

Table 4.--*Water-quality data for selected surface-water sites near the Wayne County landfill, June 1988 and July 1989*--Continued

Site number	Date	Aldrin, total recov-erable (µg/L)	Lindane, total recov-erable (µg/L)	Chlor-dane, total recov-erable (µg/L)	DDD, total recov-erable (µg/L)	DDE, total recov-erable (µg/L)	DDT, total recov-erable (µg/L)	Di-eldrin, total recov-erable (µg/L)	Endo-sulfan, total recov-erable (µg/L)	Endrin, total recov-erable (µg/L)	Tox-aphene, total recov-erable (µg/L)	Hepta-chlor, total recov-erable (µg/L)	Hepta-chlor epoxide, total recov-erable (µg/L)
17	07-13-89	<0.010	<0.010	<0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<1	<0.010	<0.010
18	07-11-89	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010	< .010
19	06-29-88	--	--	--	--	--	--	--	--	--	--	--	--
20	06-29-88	--	--	--	--	--	--	--	--	--	--	--	--
22	06-30-88	--	--	--	--	--	--	--	--	--	--	--	--
22	07-12-89	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010	< .010
23	06-30-88	--	--	--	--	--	--	--	--	--	--	--	--
23	07-12-89	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010	< .010
24	06-30-88	--	--	--	--	--	--	--	--	--	--	--	--
24	07-13-89	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010	< .010
25	06-29-88	--	--	--	--	--	--	--	--	--	--	--	--
26	06-30-88	--	--	--	--	--	--	--	--	--	--	--	--
26	07-12-89	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010	< .010
27	06-28-88	--	--	--	--	--	--	--	--	--	--	--	--
27	07-12-89	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010	< .010
28	06-28-88	--	--	--	--	--	--	--	--	--	--	--	--
29	07-13-89	< .010	< .010	< .1	< .010	< .010	< .010	< .010	< .010	< .010	<1	< .010	< .010

Site number	Date	Meth-oxy-chlor, total recov-erable (µg/L)	PCB, total recov-erable (µg/L)	Mirex, total recov-erable (µg/L)
17	07-13-89	<0.01	<0.1	<0.01
18	07-11-89	< .01	< .1	< .01
19	06-29-88	--	--	--
20	06-29-88	--	--	--
22	06-30-88	--	--	--
22	07-12-89	< .01	< .1	< .01
23	06-30-88	--	--	--
23	07-12-89	< .01	< .1	< .01
24	06-30-88	--	--	--
24	07-13-89	< .01	< .1	< .01
25	06-29-88	--	--	--
26	06-30-88	--	--	--
26	07-12-89	< .01	< .1	< .01
27	06-28-88	--	--	--
27	07-12-89	< .01	< .1	< .01
28	06-28-88	--	--	--
29	07-13-89	< .01	< .1	< .01

Table 5.--*Daily mean discharge of Banjo Branch near Waynesboro, Tenn. (03594164)*

[MAX, maximum; MIN, minimum; CFSM, cubic feet per square mile of drainage area; IN., inches; WY, water year]

	1988								1989					
DAY	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	APR	MAY	JUNE	JULY	AUG	SEPT
1	0.66	0.50	0.30	0.24	0.22	0.56	0.26	0.51	1.1	0.84	0.50	2.8	0.89	4.2
2	.60	.51	.36	.26	.21	.40	.26	.49	1.0	.67	.57	14	.77	5.2
3	.57	.49	.33	.33	.23	.28	.23	.48	2.2	.66	.53	7.5	.61	2.1
4	.65	.46	.29	.23	.29	.25	.81	.46	44	1.2	.52	3.7	.58	1.2
5	.59	.47	.26	.22	.24	.23	1.1	.43	9.7	2.8	.58	2.1	.56	.87
6	.52	.48	.24	.25	.23	.23	.40	.43	5.4	1.5	.55	1.4	.93	.71
7	.53	.50	.15	.28	.19	.24	.33	.45	5.8	.96	.50	3.6	.73	.67
8	.52	.40	.17	.26	.17	.23	.34	.44	4.7	.86	.54	4.0	.57	.67
9	.53	.41	.17	.24	.16	.22	.30	.44	3.4	1.0	.57	1.8	.52	.67
10	.48	.42	.16	.25	.17	.25	1.1	.41	2.4	1.0	.48	2.2	.52	.70
11	.47	.39	.21	.26	.25	.27	.46	.41	1.8	.81	.78	7.5	.52	.67
12	.47	.39	.36	.26	.23	.26	.44	.40	1.5	.73	.71	8.8	.50	.65
13	.42	.37	.72	.29	.22	.28	.59	.42	1.4	.71	2.9	4.4	.50	1.0
14	.42	.37	.26	.27	.21	.28	.39	---	1.3	.92	4.2	2.2	.51	1.4
15	.46	.36	.18	.26	.20	.32	.35	---	1.3	1.2	22	1.4	.50	.74
16	.56	.35	.17	.24	.88	.39	1.0	---	1.1	.76	5.6	1.2	.50	.71
17	.79	.36	.17	.19	.53	.36	.57	---	1.1	.69	2.1	1.0	1.2	.68
18	.49	.33	.17	.14	.26	.46	.41	---	1.0	.64	1.2	.83	.71	.67
19	.46	.32	.18	.15	.25	.53	.4	---	.98	.65	1.3	1.2	.57	.63
20	.46	.32	.19	.19	.25	.52	.3	---	.91	.70	.99	.87	.54	.63
21	.48	.43	.60	.18	.23	.62	.94	---	.88	.70	.81	.75	.51	.64
22	.90	.45	.26	.17	.22	.59	.50	---	.86	.63	.69	.68	.52	.89
23	2.0	.38	.23	.18	.24	.72	.41	---	.84	.74	.60	.66	.56	.88
24	3.8	.36	.21	.18	.45	.74	.36	---	.79	.59	.56	.78	.58	.66
25	2.0	.34	.24	.16	.33	.77	.36	---	.77	.57	.52	.76	.64	1.1
26	1.0	.33	.24	.15	.25	.86	15	---	.74	.56	.49	.62	.77	.90
27	.72	.30	.23	.16	.24	.93	6.8	---	.73	1.7	.47	.58	.62	.72
28	.67	.30	.21	.46	.24	.3	2.0	---	.72	.66	4.4	.58	.54	.89
29	.59	.30	.21	.34	.31	.35	.94	---	.68	.58	3.1	.57	.53	1.6
30	.57	.27	.22	.24	.28	.26	.68	---	.74	.53	3.1	.55	3.4	7.9
31	.54	---	.24	.21	---	.26	---	---	---	.51	---	.62	2.0	---
TOTALS	23.92	11.66	7.93	7.24	8.18	13.96	45.03	5.77	99.84	27.07	61.86	79.65	23.40	40.95
MEAN	.77	.39	.26	.23	.27	.45	1.50	.44	3.33	.87	2.06	2.57	.75	1.36
MAX	3.8	.51	.72	.46	.88	1.3	15	.51	44	2.8	22	14	3.4	7.9
MIN	.42	.27	.15	.14	.16	.22	.23	.40	.68	.51	.47	.55	.50	.63
CFSM	.36	.18	.12	.11	.13	.21	.70	.21	1.56	.41	.96	1.20	.35	.64
IN.	.42	.20	.14	.13	.14	.24	.78	.10	1.74	.47	1.08	1.38	.41	.71

STATISTICS OF MONTHLY MEAN DATA WATER YEAR (WY) 1988-89

	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	APR	MAY	JUNE	JULY	AUG	SEPT
MEAN	.77	.39	.26	.23	.27	.45	1.50	.44	3.33	.82	1.23	1.41	.49	.82
MAX	.77	.39	.26	.23	.27	.45	1.50	.44	3.33	.87	2.06	2.57	.75	1.36
(WY)	1988	1988	1988	1988	1988	1989	1989	1989	1989	1989	1989	1989	1989	1989
MIN	.77	.39	.26	.23	.27	.45	1.50	.44	3.33	.77	.39	.26	.23	.27
(WY)	1988	1988	1988	1988	1988	1989	1989	1989	1989	1988	1988	1988	1988	1988

SUMMARY STATISTICS	1988 CALENDAR YEAR	1988 WATER YEAR	1989 WATER YEAR	WATER YEARS 1988 - 1989	
ANNUAL TOTAL	123.69	58.93	399.23	--	----
ANNUAL MEAN	.54	.39	1.55	1.11	----
HIGHEST ANNUAL MEAN	--	--	--	1.55	1989
LOWEST ANNUAL MEAN	--	--	--	.39	1988
HIGHEST DAILY MEAN	15 (Nov 26)	3.8 (May 24)	44 (Apr 4)	44	(Apr 4) 1989
LOWEST DAILY MEAN	.14 (Aug 18)	.14 (Aug 18)	.22 (Oct 9)	.14	(Aug 18) 1988
ANNUAL 7-DAY MINIMUM	.17 (Aug 21)	.17 (Aug 21)	.24 (Oct 4)	.17	(Aug 21) 1988
ANNUAL RUNOFF (CFSM)	.25	.18	.72	.52	
ANNUAL RUNOFF (INCHES)	2.15	1.02	6.94	7.08	
10 PERCENT EXCEEDS	.75		3.1	2.0	
50 PERCENT EXCEEDS	.34		.70	.54	
90 PERCENT EXCEEDS	.19		.36	.23	

Table 6.--*Analyses of bottom-sediment samples collected from two sites near the Wayne County landfill, July 1989*

[μg/kg, micrograms per kilograms]

Site number	Date	PCN, total recoverable in bottom material (μg/kg)	Aldrin, total recoverable in bottom material (μg/kg)	Lindane, total recoverable in bottom material (μg/kg)	Chlordane, total recoverable in bottom material (μg/kg)	DDD, total recoverable in bottom material (μg/kg)	DDE, total recoverable in bottom material (μg/kg)	DDT, total recoverable in bottom material (μg/kg)	Dieldrin, total recoverable in bottom material (μg/kg)	Endosulfan, total recoverable in bottom material (μg/kg)	Endrin, total recoverable in bottom material (μg/kg)
18	7-11-89	<1.0	<0.1	<0.1	<1.0	<0.1	<0.1	0.3	<0.1	<0.1	<0.1
24	7-13-89	<1.0	< .1	< .1	<1.0	.1	.1	< .1	< .1	.1	.1
24	7-13-89	<1.0	< .1	< .1	<1.0	.3	.2	< .1	.1	< .1	< .1

Site number	Date	Toxaphene, total recoverable in bottom material (μg/kg)	Heptachlor, total recoverable in bottom material (μg/kg)	Heptachlor epoxide, total recoverable in bottom material (μg/kg)	Methoxychlor, total recoverable in bottom material (μg/kg)	PCB, total recoverable in bottom material (μg/kg)	Mirex total recoverable in bottom material (μg/kg)	Perthane in bottom material (μg/kg)
18	7-11-89	<10	<0.1	<0.1	<0.1	9	<0.1	<1.00
24	7-13-89	<10	< .1	< .1	< .1	13	.1	<1.00
24	7-13-89	<10	< .1	< .1	.1	57	.1	<1.00

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Table 7.--*Species list, total number of individual organisms, number of taxa per sample, and diversity values of benthic invertebrates for samples collected from streams near the Wayne County landfill, June 28-30, 1988, and July 12, 1989*

[--, species not present]

TAXA	June 28, 1988		June 29, 1988		
	Banjo Branch Site 27	Banjo Branch Site 28	Moser Branch Site 19	Moser Branch Site 20	Banjo Branch tributary Site 25
INSECTA					
Ephemeroptera (mayflies)					
Baetis amplus	--	--	4	--	--
Baetis tricaudatus	20	--	--	--	--
Caenis species	16	4	4	--	--
Stenonema species	--	12	4	--	--
Tricorythodes species	--	4	--	--	--
Plecoptera (stoneflies)					
Acroneuria species	4	2	--	--	--
Paraleuctra species	20	20	92	32	20
Trichoptera (caddisflies)					
Cheumatopsyche species	56	24	--	--	--
Chimarra species	--	8	--	--	--
Hydropsyche species	--	4	--	--	--
Rhyacophila vagrita	--	4	4	--	--
Trichoptera pupae	--	--	4	--	
Diptera (true flies)					
Antocha species	--	4	--	--	--
Bezzia species	4	--	--	--	--
Chironomus species	16	--	--	--	--
Cryptochironomus species	20	--	28	32	20
Eukiefferiella species 1	12	--	4	--	--
Eukiefferiella species 2	44	4	--	32	--
Glyptotendipes species	32	--	--	--	--
Micropsectra species	8	--	--	--	--
Microtendipes species	36	28	--	--	16
Orthocladius species	28	--	--	--	--
Paralauterborniella species	--	--	4	--	--
Polypedilum species 1	--	--	--	48	--
Stictochironomus species 1	4	--	--	--	4
Stictochironomus species 2	--	--	12	32	--
Thienemanniella species	68	--	--	--	--
Thienemannimyia species group	48	48	48	80	12
Tipula species	--	--	--	--	4
Tribelos species	8	12	12	128	4
Trissopelopia species	16	16	4	--	--
Zavrelimyia species	88	--	8	48	4
Chironomidae pupae	12	4	--	--	--
Coleoptera (beetles)					
Bidessini species	20	--	8	--	--
Dubiraphia species	--	4	--	--	--
Optioservus species	16	120	--	--	--
Psephenus herricki	--	20	--	--	4
Stenelmis species	--	--	4	--	--

Table 7.--*Species list, total number of individual organisms, number of taxa per sample, and diversity values of benthic invertebrates for samples collected from streams near the Wayne County landfill, June 28-30, 1988, and July 12, 1989*--Continued

TAXA	June 28, 1988		June 29, 1988		
	Banjo Branch Site 27	Banjo Branch Site 28	Moser Branch Site 19	Moser Branch Site 20	Banjo Branch tributary Site 25
Hemiptera (true bugs)					
Trepobates species	2	--	4	--	--
Odonata (dragonflies and damselflies)					
Argia species	--	1	--	--	--
Gomphus species	--	--	--	16	--
Ophiogomphus species	4	12	--	--	--
Stylogomphus species	8	--	16	--	4
Megloptera (alderflies and dobson flies)					
Nigronia species	28	55	4	--	--
HYDRACARINA (water mites)	--	4	--	--	--
CRUSTACEA					
Isopoda (sow bugs)					
Lirceus species	4	20	--	--	4
Amphipoda (sideswimmers)					
Gammarus minus	132	5	--	--	--
Decapoda (crayfish)					
Orconectes compressus	3	11	9	3	5
MOLLUSCA					
Gastropoda (snails)					
Somatogyrus species	12	--	4	--	--
OLIGOCHAETA (worms)					
Tubificidae	36	5	--	--	--
TOTAL NUMBER OF ORGANISMS	825	455	281	451	101
NUMBER OF TAXA	31	26	20	10	12
SHANNON-WEAVER DIVERSITY VALUES	4.31	3.80	3.36	2.95	3.22

Table 7.--*Species list, total number of individual organisms, number of taxa per sample, and diversity values of benthic invertebrates for samples collected from streams near the Wayne County landfill, June 28-30, 1988, and July 12, 1989*--Continued

TAXA	June 30, 1988 Hog Creek Site 22	June 30, 1988 Mill Branch Site 23	June 30, 1988 Banjo Branch tributary Site 26	July 12, 1988 Downing Branch Site 17	July 12, 1988 Moser Branch (at county road bridge) Site 29
INSECTA					
Ephemeroptera (mayflies)					
Baetis amplus	8	--	8	--	1
Baetis pygmaeus	64	--	--	29	--
Baetis tricaudatus	--	--	--	--	5
Caenis species	32	--	--	6	--
Ephemera species	--	--	--	--	1
Isonychia species	--	8	--	3	6
Stenonema species	8	20	8	24	12
Tricorythodes species	--	8	--	4	--
Plecoptera (stoneflies)					
Acroneuria species	24	24	18	--	4
Paraleuctra species	288	20	48	28	1
Trichoptera (caddisflies)					
Cheumatopsyche species	24	32	16	7	4
Chimarra species	24	12	--	--	3
Hydropsyche frisoni	8	4	--	--	--
Hydropsyche species	--	--	--	--	1
Diptera (true flies)					
Antocha species	8	4	--	10	--
Atherix species	48	--	--	13	--
Bezzia species	8	--	--	--	--
Chironomus species	--	4	--	--	--
Cricotopus species	--	--	--	3	2
Cryptochironomus species	16	4	--	--	2
Eukiefferiella species 1	--	4	--	4	3
Eukiefferiella species 2	16	--	--	15	--
Hemerodromia species	40	--	--	--	--
Micropsectra species	--	--	--	1	--
Microtendipes species	16	4	--	--	--
Orthocladius species	--	--	--	4	3
Polypedilum species 1	24	60	32	9	24
Polypedilum species 2	--	4	--	--	--
Prosimulium species	--	--	--	2	--
Simulium species	--	--	--	--	2
Stictochironomus species 2	--	4	--	--	--
Thienemannimyia species group	400	60	64	5	16
Tipula species	1	1	2	2	1
Tribelos species	40	28	16	3	--
Trissopelopia species	64	4	32	--	--
Zavrelimyia species	16	12	32	2	--
Chironomidae pupae	8	4	--	3	--

Table 7.--*Species list, total number of individual organisms, number of taxa per sample, and diversity values of benthic invertebrates for samples collected from streams near the Wayne County landfill, June 28-30, 1988, and July 12, 1989*--Continued

TAXA	June 30, 1988			July 12, 1988	
	Hog Creek Site 22	Mill Branch Site 23	Banjo Branch tributary Site 26	Downing Branch Site 17	Moser Branch (at county road bridge) Site 29
Coleoptera (beetles)					
Hydrobiomorpha species	--	--	--	--	1
Optioservus species	208	48	--	8	--
Psephenus herricki	72	44	16	10	3
Stenelmis species	24	--	24	--	11
Odonata (dragonflies and damselflies)					
Argia translata	8	--	--	--	2
Ophiogomphus species	8	20	8	--	2
Stylogomphus species	8	--	--	--	--
Megaloptera (alderflies and dobson flies)					
Corydalus cornutus	--	4	--	2	1
Nigronia species	--	8	--	--	6
Sialis species	8	--	--	--	--
CRUSTACEA					
Isopoda (sow bugs)					
Lirceus species	--	--	9	7	--
Amphipoda (sideswimmers)					
Gammarus minus	--	--	--	--	1
Decapoda (crayfish)					
Orconectes compressus	9	5	7	5	3
MOLLUSCA					
Gastropoda (snails)					
Goniobasis species	--	--	--	5	--
Somatogyrus species	32	--	--	2	--
OLIGOCHAETA					
Tubificidae	16	--	--	--	--
TOTAL NUMBER OF ORGANISMS	1,578	454	340	216	121
NUMBER OF TAXA	32	27	16	27	27
SHANNON-WEAVER DIVERSITY VALUES	3.77	4.08	3.61	4.22	4.04

Table 7.--*Species list, total number of individual organisms, number of taxa per sample, and diversity values of benthic invertebrates for samples collected from streams near the Wayne County landfill, June 28-30, 1988, and July 12, 1989*--Continued

TAXA	July 12, 1989 Hog Creek Site 22	Mill Branch Site 23	Banjo Branch tributary Site 26	Banjo Branch Site 27
INSECTA				
Ephemeroptera (mayflies)				
Baetis amplus	--	160	--	--
Baetis tricaudatus	20	544	4	--
Caenis species	--	192	--	--
Ephemera species	--	--	16	--
Heptagenia species	--	--	4	--
Isonychia species	10	96	--	--
Stenonema species	50	576	24	4
Tricorythodes species	--	32	--	--
Plecoptera (stoneflies)				
Acroneuria species	20	128	52	16
Paraleuctra species	310	416	72	--
Trichoptera (caddisflies)				
Cheumatopsyche species	--	--	4	--
Chimarra species	40	32	--	--
Hydropsyche elissoma	--	--	8	--
Hydropsyche frisoni	20	64	--	--
Potamyia species	--	64	--	--
Diptera (true flies)				
Antocha species	30	144	--	2
Atrichopogon species	--	16	--	2
Atherix species	30	48	--	--
Bezzia species	--	--	4	2
Cryptochironomus species	20	--	4	--
Eukiefferiella species 1	10	320	16	--
Eukiefferiella species 2	40	32	12	--
Hemerodromia species	30	32	4	--
Hexatoma species	10	--	--	--
Micropsectra species	--	16	--	--
Microtendipes species	--	--	--	2
Orthocladius species	10	112	8	--
Polypedilum species 1	510	1,280	84	4
Simulium species	40	64	--	--
Stitochironomus species 1	--	--	--	2
Thienemannimyia species group	140	128	124	16
Tipula species	--	16	68	--
Tribelos species	30	--	16	--
Trissopelopia species	--	16	8	--
Chironomidae pupae	--	48	--	4
Coleoptera (beetles)				
Optioservus species	40	160	--	4
Psephenus herricki	10	64	12	14
Stenelmis species	--	32	8	--

Table 7.--*Species list, total number of individual organisms, number of taxa per sample, and diversity values of benthic invertebrates for samples collected from streams near the Wayne County landfill, June 28-30, 1988, and July 12, 1989*--Continued

TAXA	July 12, 1989 Hog Creek Site 22	Mill Branch Site 23	Banjo Branch tributary Site 26	Banjo Branch Site 27
Odonata (dragonflies and damselflies)				
Argia species	10	--	--	--
Ophiogomphus species	10	64	--	12
Megaloptera (alderflies and dobson flies)				
Corydalus cornutus	34	32	--	--
Nigronia species	--	--	--	2
Sialis species	--	--	4	--
CRUSTACEA				
Isopoda (sow bugs)				
Lirceus species	--	--	8	44
Amphipoda (sideswimmers)				
Gammarus minus	--	16	--	20
Decapoda (crayfish)				
Orconectes compressus	10	10	12	--
OLIGOCHAETA (worms)				
Tubificidae	20	--	24	18
TOTAL NUMBER OF ORGANISMS	1,504	4,954	600	168
NUMBER OF TAXA	26	31	25	16
SHANNON-WEAVER DIVERSITY VALUES	3.41	3.87	3.77	3.32

Table 8.--*Species and relative abundance of periphyton collected from seven sites near the Wayne County landfill on July 12, 1989*

[?, species identification not definite]

Downing Branch (site 17)		Moser Branch (at headwaters) (site 18)	
Organisms	Relative abundance, in percent	Organisms	Relative abundance, in percent
BACILLARIOPHYTA (Diatoms)		BACILLARIOPHYTA (Diatoms)	
Order Centrales		Order Centrales	
Melosira varians	0.2	*Melosira varians*	0.8
Order Pennales		Order Pennales	
Achnanthes lanceolata	.2	*Achnanthes linearis*	2.4
Achnanthes linearis	7.9	*Achnanthes minutissima*	7.1
Achnanthes minutissima	1.9	*Cymbella minuta*	1.5
Cocconeis placentula var. *euglypta*	.2	*Cymbella tumida*	.3
Cymbella tumida	.2	*Cymbella turgidula*	2.4
Gomphonema parvulum	.3	*Cymbella* species	.3
Navicula arvensis	.3	*Gomphonema parvulum*	7.1
Navicula gottlandica	.2	*Gomphonema* species	.6
Navicula rhynchocephala	.2	*Navicula rhynchocephala*	.8
Navicula species	.3	*Navicula* species	.3
Nitzschia dissipata	.2	*Nitzschia palea*	.6
Nitzschia frustulum	.3	*Nitzschia* species	.3
Nitzschia palea	.4	*Reimeria sinuata*	.3
Nitzschia paleacea	.3	*Rhoicosphenia curvata*	.3
Reimeria sinuata	1.9	*Synedra* species	.3
CHLOROPHYTA (Green algae)		CHLOROPHYTA (Green algae)	
Gongrosira species ?	.2	*Chlorococcum* species	1.5
Mesotaenium species	.1	*Microspora* species	3.2
Scenedesmus dimorphus	.9		
CYANOPHYTA (Blue-green algae)		CYANOPHYTA (Blue-green algae)	
Anabaena species	18.3	*Chroococcus* species	3.2
Lyngbya nana	25.4	*Lyngbya* species	6.3
Lyngbya species	3.4	*Oscillatoria limosa*	4
Oscillatoria angustissima	3	*Oscillatoria* species	56.4
Oscillatoria limosa	18.9		
Oscillatoria species	14.5		
Synechococcus lineare	.3		

Table 8.--*Species and relative abundance of periphyton collected from seven sites near the Wayne County landfill on July 12, 1989*--Continued

Hog Creek (site 22)

Organisms	Relative abundance, in percent
BACILLARIOPHYTA (Diatoms)	
Order Pennales	
Achnanthes lanceolata	0.4
Achnanthes linearis	3.6
Achnanthes minutissima	2.3
Cymbella minuta	.8
Cymbella tumida	.2
Cymbella turgidula	.7
Gomphonema parvulum	.2
Gomphonema species	.2
Navicula arvensis	.7
Navicula decussis	.2
Navicula rhyncocephala	.4
Nitzschia fonticola	.2
Nitzschia frustulum	.2
Nitzschia palea	1.5
Nitzschia paleacea	.8
Reimeria sinuata	3.5
CYANOPHYTA (Blue-green algae)	
Lyngbya digueti	12.7
Lyngbya nana	33.1
Oscillatoria limosa	13.5
Oscillatoria species	24.6
Synechococcus species	.4

Mill Branch (site 23)

Organisms	Relative abundance, in percent
BACILLARIOPHYTA (Diatoms)	
Order Centrales	
Melosira varians	0.2
Order Pennales	
Achnanthes affinis	.2
Achnanthes linearis ?	.8
Achnanthes minutissima	1.3
Cymbella minuta	1.1
Cymbella tumida	.1
Cymbella turgidula	3.2
Epithemia smithii ?	.5
Epithemia species	.1
Eunotia species	.1
Gomphonema species	.1
Navicula arvensis	.1
Navicula biconica	.3
Nitzschia acicularis	.1
Nitzschia frustulum	.3
Nitzschia palea	.2
Reimeria sinuata	1.1
Synedra species	.2
CYANOPHYTA (Blue-green algae)	
Calothrix species	1.8
Lyngbya digueti	35.4
Lyngbya nana	12.7
Oscillatoria limosa	17.5
Oscillatoria ochracea ?	21.3
Oscillatoria species	.6

Table 8.--*Species and relative abundance of periphyton collected from seven sites near the Wayne County landfill on July 12, 1989*--Continued

Banjo Branch tributary (site 26)

Organisms	Relative abundance, in percent
BACILLARIOPHYTA (Diatoms)	
Order Centrales	
Melosira varians	2.6
Order Pennales	
Achnanthes affinis	0.5
Achnanthes lanceolata	1
Achnanthes linearis	6.2
Achnanthes minutissima	3.2
Epithemia species	.7
Gomphonema parvulum	.5
Gomphonema species	.7
Navicula arvensis	.3
Nitzschia acuta ?	.3
Nitzschia amphibia	.7
Nitzschia frustulum	.3
Nitzschia palea	.7
Nitzschia paleacea	1
Rhoicosphenia curvata	.7
Stauroneis anceps	.3
Surirella angustata	.3
Synedra species	.3
CHLOROPHYTA (Green algae)	
Chlorococcum species	.7
Coleochaetae species	7.3
Cosmarium species	.5
Gongrosira species ?	1
CYANOPHYTA (Blue-green algae)	
Anabaena species	20.2
Lyngbya species	1.7
Oscillatoria angustiisima	1.5
Oscillatoria limosa	17.3
Oscillatoria species	21.7
Phormidium species	7.8

Banjo Branch (site 27)

Organisms	Relative abundance, in percent
BACILLARIOPHYTA (Diatoms)	
Order Centrales	
Melosira varians	0.7
Order Pennales	
Achnanthes linearis ?	.4
Achnanthes minutissima	4.5
Cocconeis placentula var. *euglypta*	.2
Cymbella cymbiformis var. *nonpunctata*	.2
Cymbella turgidula	.2
Gomphonema parvulum	1.1
Gomphonema species	.2
Navicula arvensis	.4
Navicula atomus	.9
Navicula notha	.7
Navicula minuta	.2
Nitzschia fonticola	.9
Nitzschia frustulum	.4
Nitzschia palea	2.6
Nitzschia paleacea	1.3
CHLOROPHYTA (Green algae)	
Closterium species 1	.2
CYANOPHYTA (Blue-green algae)	
Lyngbya digueti	31.8
Lyngbya nana	3.3
Oscillatoria limosa	49.8

Table 8.--*Species and relative abundance of periphyton collected from seven sites near the Wayne County landfill on July 12, 1989*--Continued

Moser Branch (at county road bridge)
(site 29)

Organisms	Relative abundance, in percent	Organisms	Relative abundance, in percent
BACILLARIOPHYTA (Diatoms)		CHLOROPHYTA (Green algae)	
Order Centrales		*Chlorococcum* species 1	.1
		Cosmarium species 1	.1
Melosira varians	0.1		
		CYANOPHYTA (Blue-green algae)	
Order Pennales			
		Lyngbya nana	21.7
Achnanthes linearis	.4	*Lyngbya ochracea ?*	6.7
Achnanthes minutissima	3.8	*Lyngbya* species	.9
Cymbella minuta ?	.6	*Oscillatoria geminata*	2.1
Cymbella tumidula	.2	*Oscillatoria limosa*	50.8
Cymbella turgidula	.9	*Phormidium* species	4.6
Epithemia species	.4		
Gomphonema parvulum	.7		
Gomphonema species	.2		
Navicula atomus	1.5		
Navicula gottlandica	.2		
Navicula rhyncocephala	1.1		
Nitzschia frustulum	.6		
Nitzschia palea	1.5		
Nitzschia species	.4		
Reimeria sinuata	.2		
Synedra species	.2		

Table 9.--*Species of fish, number of organisms, and species richness from six sites near the Wayne County landfill, July 1989*

[--, species not present]

Common name and species	Number of organisms by site					
	Downing Branch site 17	Hog Creek site 22	Mill Branch site 23	Banjo Branch tributary site 26	Banjo Branch site 27	Moser Branch site 29
Central stone roller *Campostoma anomalum*	--	18	24	28	17	8
Rosy side dace *Clinostomus funduloides*	44	7	14	15	26	5
Rose fin shiner *Notropis ardens*	--	--	--	--	--	1
Striped shiner *Notropis chrysocephalus*	--	5	--	--	--	5
White tail shiner *Notropis galacturus*	--	--	--	--	--	3
Red belly dace *Phoxinum erythrogaster*	16	--	--	15	26	--
Fathead minnow *Pimephales notatus*	--	--	2	--	--	8
Black-nose dace *Rhinichthys atratulus*	24	--	--	3	9	--
Creek chub *Semotilus atromaculatus*	26	10	15	6	6	3
Mad tom *Noturus exilis*	--	1	4	--	--	8
Northern hog sucker *Hypentalium nigricans*	--	6	7	--	--	2
Rock bass *Ambloplites rupestris*	--	10	9	4	--	4
Green sunfish *Lipomis cyanellus*	--	--	--	--	--	2
Longear sunfish *Lepomis megalotis*	--	--	--	--	--	4
Small mouth bass *Micropterus dolomieui*	--	1	--	--	--	--
Rainbow darter *Etheostoma caeruleum*	--	--	--	3	--	--
Slabrock darter *Etheostoma squamiceps*	7	--	3	2	4	2
Rod nose darter *Etheostoma zonistium*	--	1	5	10	3	3
Mottled sculpin *Cottus carolinae*	--	3	8	7	2	--
Species richness	5	10	10	10	8	14

Quiñones, Bradfield, and Wescott

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